Pumping of magnetic fields by stratified convection: End of the storage problem?

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A long standing issue in the theory of stellar dynamos is the problem of keeping the magnetic field within the convection zone long enough for the dynamo to operate: A magnetic flux rope is typically assumed to escape the convection zone in a month or so, while the dynamo is thought to operate on a longer time scale of decades.

We present results from three-dimensional numerical simulations, of the interaction of stratified over-turning solar-like convection with a large-scale magnetic field: By the very topology of stellar convection, even a formally super-equipartion field may be held down at the bottom of the convection zone, rendering the storage problem obsolete. This effect might also explain the observations of magnetically active but fully convective late type dwarf stars.

Several simulations have been performed, with both open and closed upper boundary conditions, as well as including differential rotation: Inclusion of an open upper boundary may lead to a considerable flux loss unless the boundary is placed close to the physical boundary.

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